

# All about the Leeches of Montezuma Well

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## Introduction

Montezuma Well is a unique ecosystem with many interesting animals living within it. One very important group of animals are the freshwater leeches that make Montezuma Well their home. Most people think of leeches as nasty bloodsucking creatures with little or no worth, and no interesting behaviors, let alone any parenting skills, but this popular perception of them is way off the mark. A common misconception about leeches is that there is only one kind of leech. In fact, there are between 700 and 1000 species of leeches worldwide and they can be found in a variety of different habitats including marine, estuarine, moist terrestrial (particularly in Australia and Southeast Asia) and freshwater ecosystems. Within these habitats, leeches can be found attached to various substrates including fish and other marine creatures (marine and estuarine), underneath rocks or clinging to vegetation (moist terrestrial), or living on submerged wood, stones, and aquatic vegetation in ponds, streams, and rivers. Even if you know where to look for them, leeches can still be difficult to find since many species are often well camouflaged, blending in perfectly with their environment and making them extremely hard to locate.

Despite their close association with medieval medicine, leeches today are used for a variety of medical purposes including providing useful treatments for arthritis, blood-clotting disorders, varicose veins and other circulatory disorders and are also used in modern plastic and reconstructive surgery.

In addition to their medical uses, leeches are quite fascinating in their own right and have some very interesting behaviors. For instance, it turns out that many leech species are very good parents, caring for their young in a manner that resembles the care shown by birds or even mammals. They can care for their young in a variety of ways including building nests for them, carrying broods of eggs or young attached to their ventral surface, or even, in several species, carrying the eggs and young in an internal pouch

(like a marsupial). In quite a few cases, the parent leech also feeds its young, either directly providing nutrients across the body wall or, more frequently, by capturing and killing prey for the youngsters to feed on until they are big enough to provide for themselves. At Montezuma Well, there are four species of leeches, in the genus *Helobdella*, that have parental care, and they are found living along the margins of the Well underneath rocks, or attached to vegetation or other suitable substrates.

Because fish cannot survive within the Well, an endemic leech, *Motobdella montezuma*, has evolved to become a pelagic hunter. In fact, this is the only known species of leech that is an open water hunter! *Motobdella* spends much of its day at the bottom of the Well, safely hidden from its predators (ducks, insects, etc.) while at the same time, its primary prey, the amphipod *Hyaella montezuma*, waits higher up in the water column at around 4 meters in depth. At sunset, the amphipods move to the surface to feed on algae and at the same time the leeches move up from the depths to begin feeding on the amphipods. This is the only place in the world where we see a migration pattern like this and it involves two endemic species that are not found anywhere else in the world!

## What are leeches?

Leeches are members of the Phylum Annelida which also includes the polychaetes (marine sandworms and bristleworms) and Oligochaetes (aquatic blackworms, terrestrial earthworms). Structurally, leeches most closely resemble their nearest relatives, the oligochaetes. Like them, the leech body is composed of a series of segments, but unlike the oligochaetes, which can have a variable number of segments, leeches always have two pre-oral and 32 post-oral segments. In addition, oligochaete body segments are never subdivided and are represented by a single ring (annulus), but leech body segments are always subdivided into two or more rings (annuli) per body segment. Besides differences in body segmentation, leeches also lack the bristles (chaetae or setae) which other annelids use for locomotion, replacing them instead with a sucker at each end of the body.

## What do leeches eat?

Contrary to popular belief, not all leeches are bloodsuckers. In fact, many of them are sit-and-wait predators and feed on a variety of different invertebrates such as insects (gnats, mosquito larvae, water bugs), oligochaetes (both aquatic blackworms and their terrestrial cousins, the earthworms), amphipods (side-swimmers), and lots of different kinds of molluscs including pond snails and freshwater clams. These predacious leeches are either engulfers (ie. they swallow their prey whole) like the Montezuma Well endemic *Motobdella montezuma*, or they are equipped with a protrusible proboscis which resembles a hypodermic needle. The four species of *Helobdella* found in Montezuma Well all feed by means of a proboscis. When not in use, the proboscis is retracted into the mouth, but when a leech has located a prey item, the proboscis pops out of the mouth and the leech uses it to spear its prey and then, once the prey is subdued, the leech uses the hollow proboscis like a soda straw and sucks up the juices of its prey.

Some proboscis leeches and another type of leech (with jaws instead of a proboscis) are temporary ectoparasites on a variety of different vertebrates including fish, turtles,

crocodiles, and humans. These are the bloodsuckers and are the ones that most people think of when the word “leech” is mentioned. They don't need much introduction since they are infamous in their own right, having had starring roles in movies such as the Hollywood classic, *African Queen*, and, more recently, *Stand by Me* and even the BBC television comedy *Black Adder*. Many bloodsuckers have jaws instead of a proboscis with which to bite their hosts and depending on which family the bloodsucker belongs to, they can have either two or three jaws. The jaws look like tiny half circular saw blades, are extremely sharp, and come equipped with either tiny pointed teeth or a cutting edge. The two-jawed kinds leave a V-shaped bite and the three-jawed ones leave a Y-shaped bite. Bloodsucking or sanguivorous (blood-feeding) leeches will readily feed on fish, reptiles (turtles and crocodiles), amphibians (frogs), waterfowl (ducks, etc.), and mammals including humans, but when larger prey are scarce, they have been known to feed on earthworms or other available invertebrates to tide them over until their next blood meal. Fortunately, none of the leeches that live in Montezuma Well are bloodsuckers. Instead, they all feed on invertebrate prey and are quite harmless to humans.

Besides feeding on everything from snails to humans, leeches themselves are often preyed upon by other organisms and can form an important part of the diet of some other aquatic predators including other invertebrates such as dragonfly or damselfly nymphs and vertebrate predators such as fish and ducks.

### **How do leeches move?**

All leeches have a front and a back sucker and they can move around by alternately attaching and detaching these suckers, which lets them crawl about with a looping inch-worm like motion. Besides crawling about by means of their suckers, many aquatic species can flatten their bodies and swim, resembling eels as they move through the water. *Motobdella montezuma* is a very good swimmer and at night can be seen swimming close to the surface feeding on amphipods.

### **How do leeches find their food?**

Leeches can detect their prey with several different sets of sensory structures, some of which can be quite sophisticated. They do have simple eyes, located at the anterior end, but these are incapable of forming an image and are only used to detect changes in light intensity and possibly some movement. They rely instead either on smell/taste (chemoreception) or on detecting vibrations (mechanoreception or passive sonar) using special structures called sensilla. For example, *Motobdella montezuma* has been found to track its prey, the amphipod, *Hyaella montezuma*, by this method. It listens for the vibrations made by *Hyaella* when it swims and *Motobdella's* hearing is sophisticated enough that it can even discriminate among the different size classes of the amphipod, skipping over any that are too big or too small and homing in on those that are just the right size for it to eat. Some other kinds of leeches home in on their prey using only chemoreception. They follow the 'scent' or 'taste' of the chemicals that are emanating from the prey animal and there are other species of leeches can find and track their prey using both chemo- and mechanoreception.

## How do leeches reproduce?

Leeches are hermaphrodites and therefore each individual is both a male and a female at the same time! When ready to mate, leeches have several different options. Some species mate in such a way that both individuals will become fathers and mothers at the same time (*Motobdella montezuma* does this), others are more selective and will resist becoming a mother, but will freely mate to become the father of a brood, and some can even become both the mother and father of their own offspring (*Helobdella*)!

After mating, eggs are produced and placed within a cocoon. Most leeches then abandon the cocoons once they are ready. However, prior to abandonment, they do provide food for the developing eggs and young by filling the cocoon with a nutrient fluid. This fluid nourishes the eggs and subsequent embryos and is designed to last until the young are old enough to break out of the cocoon and fend for themselves. Once the young hatch from the cocoon, they are fully capable of caring for themselves and have no further contact with their parents. *Motobdella montezuma* attaches its cocoons to aquatic vegetation at a depth where they are safe from ducks and other waterfowl.

One aquatic leech family, the Glossiphoniidae, employs an altogether different parenting strategy. The word "leech" is generally thought to be synonymous with selfishness and exploitation, but this is definitely not the case with the glossiphoniid leeches, who are actually quite devoted parents. A variety of parental care behaviors have evolved within this family, ranging from the brooding of egg clusters in an external nest, to brooding of eggs and young on the parent's body (*Helobdella*), to keeping the eggs and young within an internal marsupial-like pouch. In each of these three different types, the parents protect the eggs from predators and also ventilate the eggs by undulating their body across them in order to insure that the eggs are adequately oxygenated. After the eggs hatch, the parents will continue to ventilate the young, protect them from predators, and will also begin to provide food for them either by capturing and providing prey (snails, oligochaetes, mosquito larvae, etc.) or by transferring nutrients across the body wall to the developing young in a manner reminiscent of a "placenta."

Some glossiphoniids, including *Helobdella*, have even progressed to the point where they have taken the next step, becoming "social" leeches. These species spend much of their time living together in aggregations of two or more individuals and have been observed sharing food with each other and even caring for juveniles that are not their own. Living in groups probably helps with capturing prey and also reduces the chance that a single leech will be killed by a predator, but it may also ensure that offspring will survive if the parent dies.

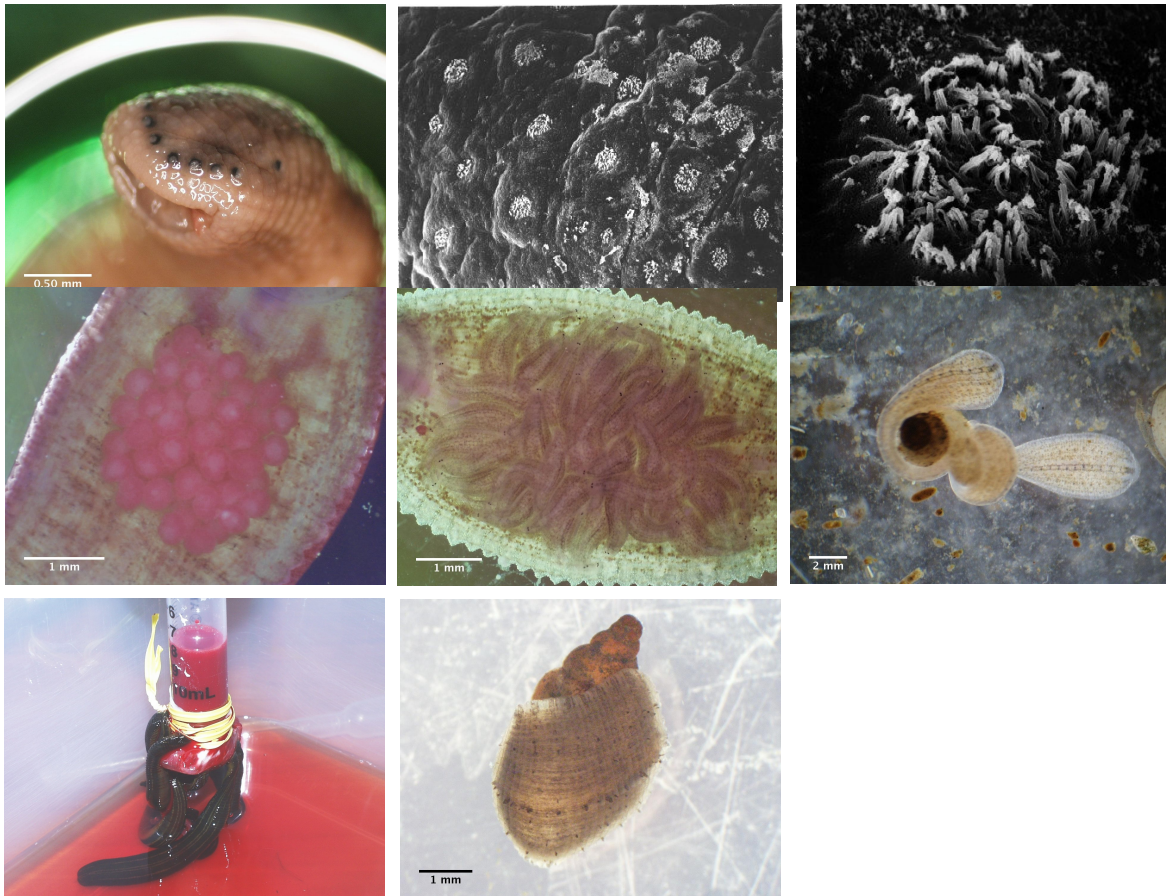


Figure 1: From left to right in top row: Australian terrestrial leech (*Philaemon*) showing its eyes. Sensilla (motion sensor) from *Motobdella montezuma* (500x) and (5000x). From left to right middle row (*Helobdella*): Eggs attached to the “stomach” (ventral surface) of their parent. Young after they hatch and remain attached to the ventral surface of their parent. Several young snail leeches feeding together on a snail. From left to right bottom row: Australian “tiger” or horse leech (*Richardsonianus australis*) feeding on horse blood. Australian snail leech (*Alboglossiphonia australiensis*) eating a snail.